Installation Guide for the *Feynman*™ Package:

FR 4.14

An *Epiphany*™ Series
Data Acquisition System

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SYSTEM COMPONENT DESCRIPTION

The *Feynman* Data Acquisition System consists of the following items:

1. *Data monitor* with separate UL listed *+15 Volt wall transformer*,
2. *RS-422 to RS-232C converter* with *+9 Volt wall transformer*,
3. Revenue grade pulse *kilowatt-hour meter*,
4. 450 Volt AC *Current/Voltage transducer*,
5. 600 Volt DC *Current/Voltage transducer,*
6. *Cluster bracket* assembly including factory-wired sensors:
    a. Ambient temperature sensor,
    b. Module temperature sensor,
    c. Anemometer (wind speed sensor),
    d. Pyranometer (solar intensity sensor) with plane-of-array bracket.
7. *Epoxy* for mounting the module temperature sensor to the back of the module, and
8. *Screwdriver* for operating the terminals on the data monitor.

See Figure 1 for a picture of components.

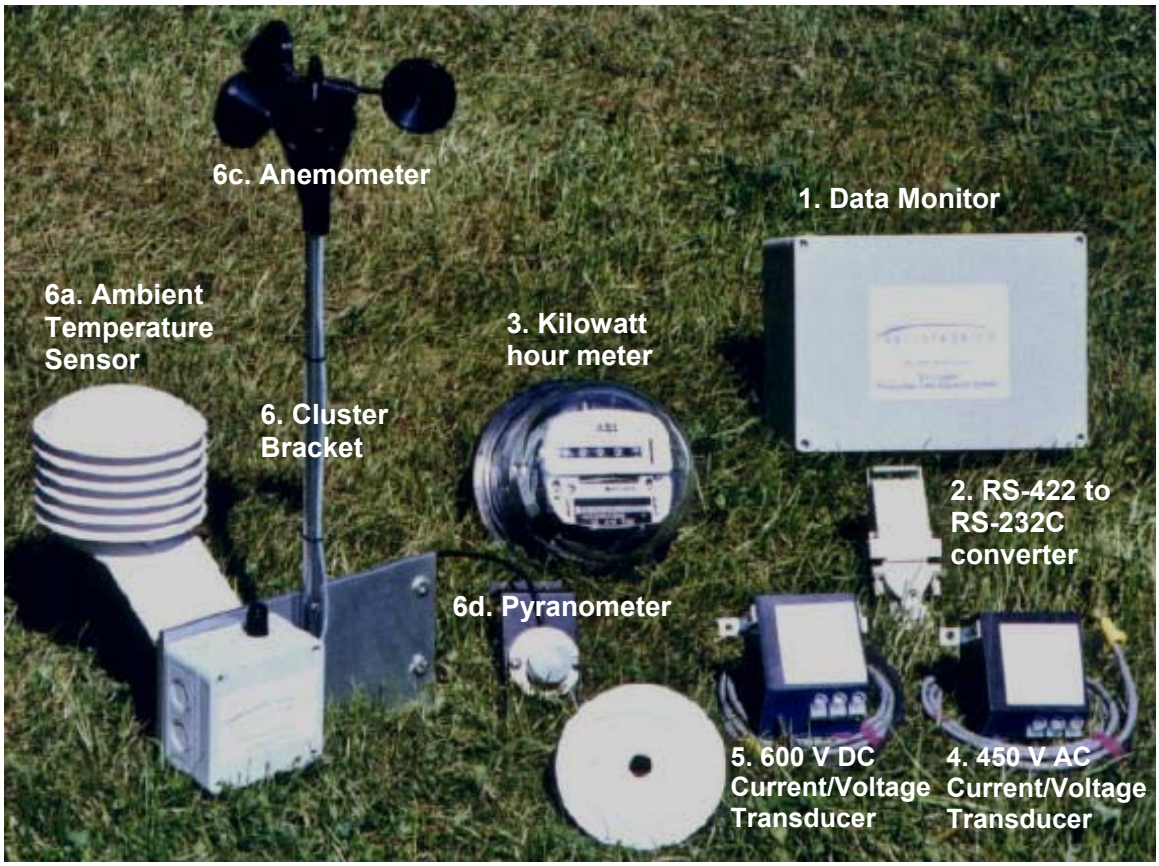


Figure 1. *Feynman* data acquisition system components. The module temperature sensor, wall transformers, screwdriver, and epoxy are not shown.

SYSTEM INSTALLATION

Typically the *data monitor*, *current/voltage transducers*, and *kilowatt-hour meter* are mounted near the inverter. See Figure 2 for the layout of a typical installation. It is recommended that the *data monitor* be mounted indoors. If it is desirable to mount it outdoors, contact Heliotronics Technical Support at 617-730-5436.

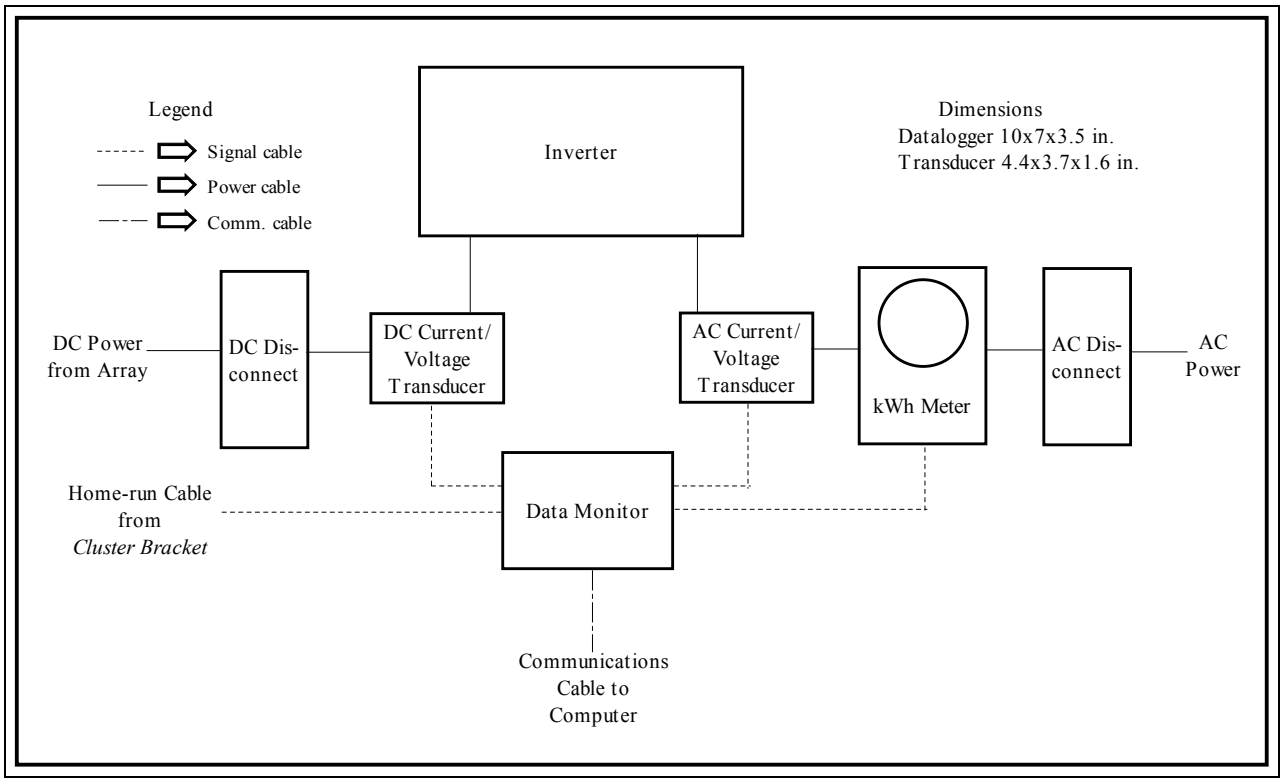


Figure 2. Example of hardware layout.

Throughout this guide you may want to refer to the detailed system wiring schematic provided in Appendix A and the Data Monitor Terminal Map provided in Appendix B.

WARNING: The *Current/Voltage Transducers* are sensitive to static electricity. To prevent damage due to static discharge during shipping, the *Current/Voltage Transducers* are shipped with a wire nut shorting the wires at the end of its cable. Once this wire nut is removed, a static wrist strap should be used until the unit is wired into the data monitor and the data monitor is grounded. Otherwise the transducer may be damaged. **DAMAGE FROM STATIC DISCHARGE IS NOT COVERED BY THE WARRANTEE.** Installers unfamiliar with the handling of static sensitive components should contact Heliotronics, Inc. technical support at 617-730-5436.

CLUSTER BRACKET INSTALLATION

The *Cluster Bracket* should be mounted level and near the solar array. For accurate wind speed readings, the anemometer should be above any obstructions. Figure 3 shows a typical *cluster bracket* installation.

Figure 3. *Cluster Bracket* and plane-of-array pyranometer installed on a PV module.

All the meteorological sensor wires are connected to a terminal block residing in the small junction box on the cluster bracket. The installer needs to install a single "home run" cable from the *Cluster Bracket* junction box to the location of the data monitor. The "home run" cable should be eight-conductor AWG 22-24 shielded, twisted pair. Note: the cable should be shielded, though the individual pairs need not be. The cable should be fed through the bottom of the junction box and connected to the terminal block. Refer to the wiring schematic in Appendix A. Note that the pyranometer's bare copper conductor must be cut and disconnected from the terminal block.

Table 1. *Cluster* Bracket junction box wiring map. Terminal block position 1 is in the upper left corner and position 12 is in the lower right corner.

	SENSOR	SENSOR WIRE COLOR	HOMERUN WIRE COLOR (FILL IN)	DATA MONITOR TERMINAL
1	Anemometer	Black		Wind Speed0-
2	Anemometer	Red		Wind Speed0+
3	Pyranometer	Copper(cut and disconnect)		GND
4	Pyranometer	Black or Green		Insol-
5	Pyranometer	Red or White		Insol+
6	Ambient Temperature	Black		Temp0-
7	Ambient Temperature	Red		Temp0+
8	Module Temperature	Black		Temp1-
9	Module Temperature	Red		Temp1+
10	Wind Vane	Not used		Not connected
11	Wind Vane	Not used		Not connected
12	Wind Vane	Not used		Not connected

Pyranometer Installation

The pyranometer should be mounted parallel to the plane of array in an un-shaded location. The recommended mounting location is on the module rail. Two self-tapping screws are included. If the pyranometer must be mounted to the frame of the solar module, it is recommended that the installer check with the module manufacture to confirm that this will not void the module warranty.

Module Temperature Sensor Installation

The module temperature sensor should be mounted to the bottom of the solar module with thermally conductive epoxy (included with the *Feynman* Data Acquisition System). Refer to Figure 4 for a picture of the installed module temperature sensor.

Figure 4. Photograph showing attachment of the module temperature sensor to the back of the photovoltaic module.

The sensor should be mounted in the center of the module. To install the module temperature sensor, use the following procedure:

1. Clean and dry the location on the module where the sensor will be installed.
2. Using strips of electrical tape, secure the temperature sensor wire to the back of the module. Make sure that the sensor itself is touching the back of the module.
3. DO NOT OPEN EPOXY! Remove the green clip from the epoxy packet.
4. Place the packet on a smooth flat surface and use the white rod like a squeegee to mix the epoxy in the unopened packet. Push one component of the epoxy toward the other in the envelope. Then repeat back in the other direction until the epoxy is completely mixed.
5. Open the envelope and apply a glob of epoxy over the temperature sensor. The white rod works well for this. Verify that there are no air bubbles in the glob of epoxy.
6. Apply small globs of the epoxy to the wire in four to six spots about 6 inches apart to secure the wire to the module.

KILOWATT-HOUR METER INSTALLATION

The *Feynman* Data Acquisition System and the included kilowatt-hour meter are compatible with 240, 208, and 120 Volt systems. The meter socket should be wired so that the "load" side is connected to the utility and the "line" side is connected to the inverter. It is best to install the kilowatt-hour meter close to the data monitor to avoid splicing additional signal wire. Route the signal wire to the data monitor and connect as indicated in Table 2.

Table 2. Kilowatt-hour meter wiring map.

WIRE COLOR	DATA MONITOR CONNECTION POINT
Yellow	Dig Aux 0
Red	GND

CURRENT/VOLTAGE TRANSDUCER INSTALLATION

Two *Current/Voltage Transducers* are supplied with the *Feynman* Data Acquisition System. The **600 Volt transducer is installed on the DC side of the inverter** and the **450 Volt transducer is installed on the AC side of the inverter**. Check the transducer label to ensure that the transducer is installed in the proper location.

Typically each transducer is installed in a dedicated eight by eight inch steel electrical box that can be obtained at the electrical supply store.

WARNING: Remember that the *Current/Voltage Transducers* are sensitive to static electricity. To prevent damage due to static discharge during shipping, the *Current/Voltage Transducers* are shipped with a wire nut shorting the wires at the end of its cable. Once this wire nut is removed, a static wrist strap must be used until the unit is wired into the data monitor and the data monitor is grounded. Otherwise the transducer could be damaged. **DAMAGE FROM STATIC DISCHARGE IS NOT COVERED BY THE WARRANTEE.** Installers unfamiliar with the handling of static sensitive components should contact Heliotronics, Inc. technical support at 617-730-5436.

For a schematic of the *Current/Voltage Transducer* connections, see the *Feynman* Installation Schematic at the end of this guide (Appendix A). Also see Table 3 for a list of the *Current/Voltage Transducer* connections on the AC side and Table 4 for connections on the DC side of the inverter.

Table 3. *Current/Voltage Transducer* connections on the AC side of the inverter.

CURRENT/VOLTAGE TRANSDUCER CONNECTIONS OR WIRE COLOR	CONNECTIONS FOR 120 VOLT SYSTEM	CONNECTIONS FOR 208/240 VOLT SYSTEM
Red	+12V on data monitor	Same as 120V
White	AC V on data monitor	"
Blue	-12V on data monitor	"
Green	Vcc on data monitor	"
Orange	Analog Aux 0- on data monitor	"
Black	GND on data monitor	"
Line AC/DC	Line	Line 1
Neutral In	Neutral from utility	Line 2 from utility
Neutral Out	Neutral from inverter	Line 2 from inverter

Table 4. *Current/Voltage Transducer* connections on the DC side of the inverter.

CURRENT/VOLTAGE TRANSDUCER CONNECTIONS OR WIRE COLOR	CONNECTIONS FOR THE DC SIDE
Red	+12V on data monitor
White	Pos DC V on data monitor
Blue	-12V on data monitor
Green	Vcc on data monitor
Orange	Analog Aux 1- on data monitor
Black	GND on data monitor
Line AC/DC	+DC
Neutral In	-DC from inverter
Neutral Out	-DC from array

SERIAL COMMUNICATIONS INSTALLATION

Epiphany™ series data acquisition systems are equipped with an RS-422 serial communications interface to allow long cable runs (up to 4000 feet) between the data monitor and the computer. We recommend using four conductor shielded CAT 5 cable.

Connect one pair from the communications cable to the "+R" and "-R" terminals on the data monitor, and connect the other pair to the "+T" and "-T" terminals on the data monitor. These terminals are located on the small daughter board in the data monitor. Route the cable to the appropriate computer (where the software will be installed). At the computer, connect the communications cable to the RS-422 to RS-232C converter as indicated in Table 5. The RS-422 to RS-232C converter should then be connected to the computer's COM1 serial port. **NOTE:** Review table 5 carefully. T stands for transmit and R stands for receive. The transmit connections at the monitor connect to the receive connections at the RS 422 – RS 232 converter. So +R at the monitor goes to T+ at the RS 422 – RS 232 converter. Similarly with the other three connections.

Table 5. RS-422 to RS-232C converter connections.

DATA MONITOR CONNECTION POINT	COMMUNICATION LINE WIRE COLOR (FILL IN)	RS-422 TO RS-232C CONVERTER CONNECTION POINT
+R		T+
-R		T-
+T		R+
-T		R-

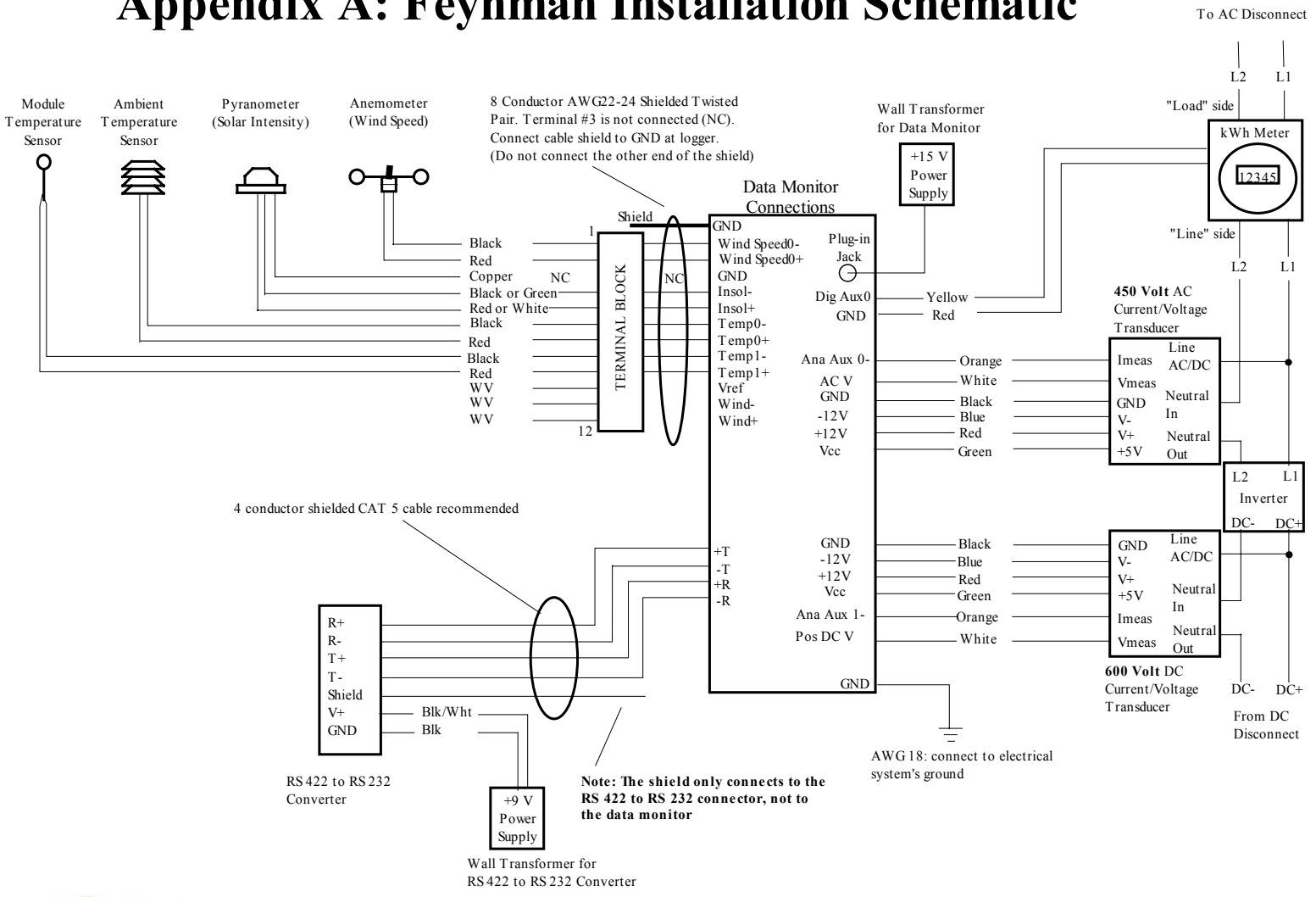
The RS-422 to RS-232C converter requires power from the supplied +9 Volt wall transformer. The transformer is often pre-wired at the factory, however if it is not, then refer to the system wiring schematic in Appendix A. Connect the striped (black and white) wire from the +9 Volt wall transformer to the *+V* terminal on the converter, and connect the solid black wire from the +9 Volt wall transformer to the *GND* terminal on the converter.

DATA MONITOR POWER INSTALLATION

A +15 Volt wall transformer is provided with the *Feynman* Data Acquisition System to power the data monitor. The transformer plugs into the jack on the upper right corner of the data monitor motherboard. Note that the wall transformer is **RATED FOR INDOOR USE ONLY**.

One of the terminals marked "GND" (see Appendix B) on the data monitor should be connected to the electrical system's ground. Use a wire size of AWG 18 for the ground connection.

Appendix A: Feynman Installation Schematic



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Appendix B: Data Monitor Terminal Map - RS 422